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Abstract

Purpose – The United Kingdom (UK) Government is required to meet various renewable energy targets set by the European Union. The UK has had renewables support schemes for many years. It has become clear that the old schemes are insufficient to lead to enough new capacity to meet the target. The government has accordingly reformed the renewables obligation (RO). The purpose of this paper is to analyse whether the reformed RO will meet the targets set for 2015 and 2020.

Design/methodology/approach – The paper undertakes a review of the modelling literature and performs a critical, deductive analysis of the RO to answer its research issue.

Findings – The paper finds that it is too late to make any difference to the 2010 target, but that the reforms might lead to the 2015 target being met, and finds that whilst it is clear that the reformed RO will lead to more capacity being built than otherwise would have been the case, it is difficult to establish that the 2020 target will be met.

Originality/value – This paper shows that there may be further reform of the already-reformed RO, and that more time is needed to see the impacts of the recent regulatory responses to the external failures. This understanding will be useful in developing new policies to promote renewable energies in the UK.

Keywords United Kingdom, Renewable energy, European directives

Paper type General review

1. Introduction

The promotion of renewable energy for power generation lies at the heart of the European Unions (EU) long-term energy policy. Since the European Commission (EC), 1997 adopted the "White Paper for a Community Strategy and Action Plan, Energy for the Future: Renewable Sources of Energy" in 1997, the EU has been working towards setting increasingly ambitious targets for renewable energy consumption: a 12 per cent share of renewable energy in overall EU energy consumption by 2010 and 20 per cent by 2020. The adoption of the directive on the promotion of the use of energy from renewable sources in December 2008 made the 2020 target legally binding (EurActiv, 2009).

Consistent with the increasingly accepted sectoral approach[1] to meeting these targets, the adoption in 2001 of the EU Directive (Directive 2001/77/EC, European Union, 2001) to promote electricity from renewable energy sources (RES-E) set the

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target of producing 21 per cent of total community electricity consumption from RES-E by 2010 (Ringel, 2006; Verhaegen *et al.*, 2007). For the United Kingdom (UK), the updated primary RES-E targets are: 10 per cent (2010) and 15.4 per cent (2015), with 30-35 per cent proposed for the 2020 target (out of a legally binding target of 15 per cent of overall total energy consumption). The means by which these targets are to be achieved, however, has been left to the decision of the individual member states (Daniëls and Uyterlinde, 2005). Currently, two main instruments currently dominate the policy landscape: variants of the renewable energy feed-in tariffs (REFIT) and the renewables portfolio standard (RPS) (Komor, 2004; Malloy, 2006).

The UK has had a specific delivery programme for RES-E since 1990 (Mitchell and Connor, 2004). There have been two main policy instruments: the non-fossil fuel order (NFFO), a centralised bidding system that ran from 1990 to 1998, and the renewables obligation (RO), a variant of the RPS – a tradable green certificate (TGC)/quota system that came into effect in April 2002 (Mitchell *et al.*, 2006).

The 2007 "White Paper on Energy: Meeting the Energy Challenge" (Department of Trade and Industry (DTI), 2007a) detailed the government's intentions with regard to reforming the RO (hereafter termed the "reformed RO"): primarily this includes introducing banding to provide differentiated levels of support for different technologies and increase the obligation level to a maximum level of 20 per cent. The reasoning behind reforming the RO is that research, based primarily on modelling by Oxford Economic Research Associates (OXERA, 2007) and Ernst & Young (2007), indicates that leaving the RO unchanged means that the 2010 (10.4 per cent), 2015 (15 per cent) and 2020 (proposed 30-35 per cent) targets will not be achieved (Department of Business, Enterprise and Regulatory Reform (BERR), 2008d). For 2008, RES-E contributed 5.5 per cent of all electricity generation (against the yearly target of 7.9 per cent) and all renewables (including electricity, heat and transport) accounted for only 2.5 per cent of UK total primary energy requirements (Department of Energy and Climate Change (DECC) 2009b). OXERA (2007) modelling indicates that the non-reformed RO would only attain 7.9 per cent in 2010, 11.4 per cent in 2015 and 12 per cent in 2020, a clear failing of the target. In contrast, it is anticipated that a banded RO will increase renewables deployment by over 40 per cent for the period 2009-2015 compared to the existing RO (DTI, 2006). The indicators discussed in the paper show that the reformed RO is expected to produce a result closer to the target than its predecessor would have delivered.

The NFFO and original RO have not met UK renewable energy policy objectives: they have failed to deliver deployment at expected levels, stimulate the full economic exploitation of RES-E, encourage UK industry to develop capabilities for both domestic and export markets nor significantly promoted energy diversity/security. Overall, this will negatively impact greenhouse gases emission reduction targets – including a legally binding target of cutting carbon dioxide emissions by at least 80 per cent in 2050 (DECC, 2009a).

This paper is concerned with investigating two main questions: will the reform of the RO improve, maintain or decrease the level of renewable energy deployment as is projected for the current RO? Will the RES-E targets be reached on time? The OXERA projections will be re-examined by analysing the impact that the internal and external failures of the reformed RO are likely to have on renewable energy deployment levels in the UK for the 2010, 2015 and 2020 targets.

Internal (or structural) failures are those failures (barriers) due to the design of the mechanism itself, whereas external failures are those barriers out with the mechanisms direct control (cf. Wood, 2010, for an analysis of internal and external failures in UK renewable energy policy for the NFFO, RO and the reformed RO). Such an approach will be able to address additional questions: what are the failures (if any) of the reform of the RO, and if so, what are the factors that are the underlying cause for such failures? Are these addressed in the reform process?

The UK Government's decision to continue with the RO mechanism itself, and to reform it, could have significant implications relevant to the ongoing debate in the EU regarding the effectiveness of both schemes (REFIT versus RPS) – the EC supports a market-orientated pan-EU harmonised promotional tool and a common market in TGCs. Currently, the REFIT schemes (at least for Germany and Spain, and previously Denmark) are being increasingly viewed as superior: in terms of deployment levels (Butler and Neuhoff, 2008; Mendonça, 2007), industry and employment growth in the renewables sector and costs average to maximum support levels (Lipp, 2007). There is already some momentum in the UK to wholly replace the RO with a feed-in tariff mechanism. Invariably, given the alternatives available, questions will arise over the justification of keeping the RO mechanism, reformed or not, if it continues to fall behind in the set targets and other associated renewable energy policy objectives. An evaluation of the likely impact of the RO reform on potential renewable deployment levels, then, can aid in determining the answer.

This paper will be set out as follows: Section 2 will set out the changes that constitute the reformed RO. Section 3 will examine the likely impact that the reform of the RO will have on the deployment of renewable energy in the UK up to 2020. Two main areas will be examined with regard to the potential performance of the reformed RO:

(1) the internal and external failures of the mechanism; and

(2) whether the set targets for RES-E are likely to be achieved or not.

In addition, it will also be necessary to assess the model developed by OXERA (2007) that underpins government reasoning for the reform process and the design of the process itself. Finally, Section 5 will present the conclusions.

2. The reform of the renewables obligation

The 2003 Energy White Paper "Our Energy Future – Creating a Low Carbon Economy" publicly announced for the first time the government's intention to review the RO (DTI, 2003). This led to the publication of the 2006 Energy Review (DTI, 2006), which made clear the government's commitment to reform the RO mechanism whilst maintaining the fundamentals of the RO – it mitigates producers price and volume risk, aiming to support renewables closer to market rather than support new technology research. The major changes proposed included: banding the RO to provide differentiated levels of support for different technologies; to ensure that the level of the obligation always remained above renewable generation (headroom) up to a total of 20 per cent (when justified by growth in renewable generation); and amending the RO to remove the risk of unanticipated Renewable Obligation Certificates (ROC) oversupply.

The 2007 "Energy White Paper: Meeting the Energy Challenge" (DTI, 2007a) built on the proposals to reform the RO. In addition to the proposed changes mentioned above, a number of further alterations were suggested in the consultation process that were ultimately not adopted, including removing the retail price index (RPI) link to the buy-out fund from 2015/2016 to mitigate the increasing cost of the RO to consumers and remove the 10 per cent cap on co-firing.

The White Paper led to the consultation process that ran from 2007 to 2008, involving feedback from 174 companies (generators, suppliers, supply chain companies and competing sectors), organisations (including trade associations for renewable industries and competing industries and non-governmental organizations) and individuals. The government response to the RO consultation (BERR, 2008b, c) sets out the amendments to the RO reform and as such forms the basis of this section.

The government has recognised that deployment levels will fail to meet the RES-E targets of 2010 (10 per cent) and 2015 (15.4 per cent) if the RO was maintained in its previous (non-reformed) version. As such, the reasoning behind the reform of the RO is that it:

> [. . .] will provide the flexibility necessary to increase the deployment of renewable electricity generation in the years following 2009 and respond to the UK share of the EU 2020 target [. . .] [by over-coming the] constraints on the availability and deployment of the cheaper forms of renewables which mean that, to meet the government's long-term targets for renewable energy, we will need a significant contribution from renewable sources that are currently more expensive (DTI, 2007b, p. 3).

In addition, the government has recognised the urgent need to resolve issues of planning and grid constraints (external factors) that, in conjunction with the reform of the RO, are expected to improve the situation of renewables in the UK by reducing development costs and risks to investors (see further Section 3).

2.1 The changes to the renewables obligation

In line with the governments aim to promote the development of renewables at a reasonable cost to consumers using a market-based mechanism with emphasis strongly placed on economic efficiency (i.e. at least cost), the decision to band the RO was decided primarily by assessing the expected current and forward costs over the next few years for each technology. The principal costs were defined as capital costs and fuel costs (e.g. for biomass). Ernst & Young (2007) carried out an analysis and informal consultation, and the findings of this cost-benefit analysis were then utilised in modelling the electricity market (OXERA, 2007).

As the consultation report (DTI, 2007b, p. 13) states:

> We have found that these costs seem to fall into loose groupings, which reflect at least in general terms the market and technological development have reached to date [. . .] [And] taking these sources of cost into account the Government has identified groups which can in the initial phase of a banded RO be treated in similar fashion.

The government stated three main objectives for introducing banding to the RO: to bring on additional technology by providing appropriate levels of support and certainty for future investments through the RO whilst maintaining broadly similar costs to the consumer; to protect the position of existing renewable energy projects and investors (including projects already under construction prior to the introduction of the new regime); and allow adjustments to the RO to avoid over-subsidisation of technologies as costs and revenues evolve. In other words, banding would increase total renewables growth and increase RO efficiency in terms of renewable capacity with only moderate increases in costs to consumers.

Table I shows the five designated bands with their associated technologies and the level of support allocated from 1 April 2009. New RO-eligible technologies include geopressure and tidal impoundment. The design of the banding structure takes into account the level of maturity and level of risk facing the particular renewable energy technologies (RETs) – from low-risk/mature (established 1 band) up to high-risk technologies in the development stage that require far more support in order to reduce costs and risks (Emerging Band) in addition to technology-specific issues. For example, both established bands include those technologies that will obtain a reduced amount of ROCs/MWh. These include relatively low-risk, mature RETs requiring low levels of capital investment, with co-firing on non-energy biomass in coal-fired power stations receiving additional benefits (increased incentives from the additional avoided costs from the EU Emissions Trading Scheme (EU ETS) – carbon price). The cap on co-firing (with the exception of energy crops) will be retained at 10 per cent to mitigate concerns about the potential volatility of co-firing volumes and thus the potential impact on the ROC market (this will be discussed in more detail later).

The reference band includes relatively mature RETs but require significant capital investment. Although onshore wind has significant potential to deploy new capacity over the lifetime of the RO, its cost-effectiveness could decline due to the utilisation of all the best sites and increasing equipment costs (for the turbines and the raw materials to produce them). Supply chain under-development and land-use issues are seen as constraining co-firing with energy crops (Gross, 2004).

The post-demonstration band includes offshore wind and dedicated biomass power stations, two RETs with significant potential to undergo large-scale deployment in the

Band	Technologies	Level of support
Established 1	Landfill gas	0.25
Established 2	Sewage gas; co-firing on non-energy (regular) biomass[a]	0.50
Reference	Onshore wind; hydroelectric; co-firing of energy crops; EfW[b] with CHP[c]; geopressure; other not specified[d]	1.0
Post-demonstration	Offshore wind[e]; dedicated regular biomass	1.5
Emerging	Wave; tidal stream; dedicated biomass burning energy crops (with or without CHP); dedicated regular biomass with CHP; solar photovoltaic; geothermal; tidal impoundment (tidal lagoons and tidal barrages <1 GW); fuels created using an advanced conversion technology[f]; microgeneration (<50 kW)[g]	2.0

Notes: [a]Technologies in the established bands are banded down; [b]energy from waste (EfW); [c]combined heat and power (CHP); [d]projects that apply for accreditation under the RO and future technologies that have not been allocated a particular band will join the RO in the reference band until the next banding review; [e]offshore wind will receive 2 ROCs/MWh for 2010/2011, 1.75 ROCs/MWh for 2011/2012 then revert back to 1.5 ROCs/MWh from 2012/2013 onwards; [f]includes anaerobic digestion, gasification and pyrolysis; [g]microgeneration is placed in the highest band to compensate for its exclusion from grandfathering and reduce complexity for microgenerators – this support level will be retained following the first scheduled banding review planned for 2013

Table I. Proposed technology bands and levels of support (ROCs/MWh) near future (offshore wind has greater deployment potential over the period to 2015 than onshore wind), but face higher risks and costs specific to this RET). This is the reason why government increased the number of ROCs allocated for offshore wind in the 2009 budget (Table I), valued at £525 m of extra support (Renewable Energy Association, 2009). Both technologies have been under-supported by the current RO, and for dedicated regular biomass power stations, increased benefits include the avoidance of the Landfill Tax payments by burning fuels that would otherwise be buried in landfill sites.

The Emerging Technologies Band includes those RETs that need to show much greater cost reductions in order to become competitive even with other renewables and whose scope for large-scale deployment is uncertain. Most of the technologies in this band are recognised as requiring support from additional schemes as well as receiving higher support levels (in numbers of ROCs/MWh) under the reformed RO, e.g. the UK biomass strategy support measures (for advanced conversion technologies and dedicated biomass power stations with CHP), the Marine Research and Development Fund, Carbon Trust and Devolved Administrations (for wave and tidal stream), the microgeneration strategy (launched in 2006) to streamline the process for microgenerators in the RO in conjunction with capital grants from the Low Carbon Buildings Programme (LCBP) (phases 1 and 2, totalling £86 million) and the PV demonstrator and Clear Skies Capital grant initiatives from the LCBP. In particular, wave and tidal stream have a huge potential for deployment that, due to inadequate support under the non-reformed RO were expected to make no real significant contributions to UK energy until 2020 (Ernst & Young, 2007).

With regard to the broad approach to banding the RO, the government chose the multiple-fractional ROC approach over the multiple obligation approach (Table II). This approach awards more than 1 ROC/MWh (multiple ROCs) to some technologies and less than 1 ROC/MWh (fractional ROCs) to others whereas the multiple obligation approach would establish separate obligations for the different technologies with different buy-out prices and targets. The government chose the former approach for a number of reasons: decisions as to the appropriate generation mix are left to the market[2], thus promoting better decision making that takes into account all aspects of project development and operation; it reduces the overall complexity of banding (thus the government does realise that banding makes the RO more complex); and it simplifies the protection of existing projects.

The creation of a banded multiple ROC obligation has a fundamental effect on the way in which the mechanism operates. The mechanism places an obligation on electricity suppliers to supply a certain amount of eligible renewable electricity (evidenced by presenting ROCs) or to pay a buy-out price. In a banded RO, however, because one ROC will no longer necessarily be equivalent to one MWh of renewable electricity as it will depend on the technology, the number of ROCs presented by an electricity supplier will no longer exactly represent the volume of renewable energy in MWh supplied by the supplier. This has two further effects. First, it will require the existing legislation, which places an obligation on electricity suppliers to supply a certain amount of eligible renewable electricity (evidenced by presenting ROCs) or to pay a buy-out price, to be converted to one where suppliers are obliged to present a specified number of ROCs (or pay a buy-out price). Second, because the banded multiple ROC obligation:

Table II. The changes to the renewables obligation

1. Banding	(a) Five bands to be created[a] (established 1 and 2, reference, post-demonstration and emerging)
	(b) Technologies with similar costs (based on an assessment of expected current and forward costs over the next few years for each technology) are grouped together
	(c) Banding based on a multiple-fraction ROC approach
	(d) The frequency of banding settings will be linked to the EU ETS scheme – currently expected to be 1 April 2013 and 1 April 2018
	(e) Any changes will be announced 18 months prior to the introduction of such changes as specified in a review; reviews of bands will occur every three to five years[b]
2. Grandfathering	(a) Trigger point for grandfathering based on the date of planning consent[c]
	(b) Any reduction in the number of ROCs/MWh will only apply to future projects with the exception of co-firing
	(c) Co-firing and microgeneration will not benefit from the principle of grandfathering
	(d) No intention to curtailing ROC entitlement of capacity before 2027 (except co-firing)
	(e) Duration of grandfathering will remain at 20 years[d]
3. Level of obligation	(a) The government is committed to maintain RO levels above renewable generation up to a total of 20 per cent[e]
	(b) This will be done on a guaranteed headroom basis of 8 per cent[f]
4. Co-firing and biomass sustainability	(a) Although the cap on the proportion of a supplier's obligation that can be met by co-fired ROCs will remain at 10 per cent, an emergency criterion review would be triggered if co-fired ROCs (except co-firing energy crops) surrendered exceeded 10 per cent of the total obligation
	(b) A requirement to report annually to OFGEM on the sustainability of biomass used in generation, with the exception of stations with a capacity of 50 kW and under
	(c) Deeming the biomass fraction of waste with a deemed level of 50 per cent fossil fuel energy content will be permitted (this will increase to 65 per cent in line with the governments waste policy
5. Funding for RO administration costs	Administration costs will be taken from the buy-out fund[g] with the government making up the difference in the event of a shortfall[g]

Notes: [a]Previously, four bands were proposed (no established band 2) to reduce complexity; [b]however, see in text regarding the trigger criteria for allowing early reviews to occur in extreme circumstances; [c]previously, the first supply of electricity for which ROCs were claimed was the trigger point; [d]during the consultation process a shorter duration (15 years) was suggested; [e]this is not a commitment to increase RO levels to 20 per cent by 2020; [f]previously, 6 per cent guaranteed headroom was proposed; [g]previously, these costs were paid by OFGEM through license fees from the gas and electricity network operators

Sources: BERR (2008b); DTI (2007b)

> [. . .] breaks the existing direct link between the overall size of the electricity market and the actual amount of renewable electricity which would be required to meet the RO (DTI, 2007b, p. 11).

It means that the decisions on the bands might have the effect of putting more ROCs into the market than the number of MWh generated (net banding up) or fewer ROCs than MWh (net banding down), thus affecting the net neutrality of the RO. Although net banding up or down becomes inevitable, the setting of bands and the need to achieve a broad balance between the additional supply of ROCs by banding up certain technologies and reduced supply by banding down certain technologies becomes important, particularly in terms of retaining credibility of the RO as the key mechanism for achieving the renewable energy targets.

In order to maintain a stable and predictable system for investors and developers, the review process (which will determine changes to support levels over time to reflect changes in RET costs and other market developments) will occur on a time basis rather than being triggered by the deployment of a particular volume of generation capacity. This will happen every three to five years with any changes to banding being announced 18 months prior to the introduction of the changes. Implementation of the changes will be linked to the EU ETS scheme – 1 April 2013 and the 1 April 2018. This was decided because the support level required for renewables in the future is to be increasingly dependent on the carbon price. However, offshore wind has already been effectively banded-up, albeit temporarily, virtually simultaneously with the commencement of the reformed RO.

Table II summarises the main changes to the RO. Early banding reviews can be triggered in extreme circumstances with a broad set of criteria to trigger the early review (a review can be triggered following one or a combination of the criteria being met). These include: if another major support scheme with an impact on renewables starts, ends or is subject to significant changes; co-firing cap creates significant distortions in the ROC market[3]; over-compliance of the obligation; other unforeseen event with a significant impact on the RO's operation; significant changes in grid connection/transmission; demonstrated significant variation in net costs for a specific technology that changes the economic rationale for setting banding levels; and if a new technology with the ability for large-scale deployment arises.

There is also the process for setting of the bands during future review periods. The success of a banded mechanism will strongly depend on the inclusion of the appropriate RETs to the appropriate band. A number of criteria have been established in order to help achieve this. These criteria include: taking into account full project costs (planning, construction and grid issues), income (wholesale price of electricity, avoided costs of the EU ETS, CCL and Landfill Tax), supporting the aim to maximize deployment in a sustainable manner, taking into account net neutrality, taking into account the cost-effectiveness and long-term potential of various RETs in delivering the set targets (for renewable generation) and wider strategic issues (e.g. sustainability, carbon emission reductions).

The position of those who have made significant investments will be protected (in terms of the numbers of ROCs they receive) under the principle of grandfathering as established in the 2006 Energy Review Report. However, there are two exceptions: co-firing (except with energy crops) and microgeneration will not benefit from grandfathering (Table II). In addition, the government will permit those projects in receipt of grants coming into operation after 11 July 2006 (the date of the 2006 Energy Review) using technology that will be banded up under the proposed changes to repay the relevant proportion of the grant they received and thus move up to the new band. This option should smooth generation growth by mitigating against delays while investors and others wait for the introduction of higher bands.

The proposed changes with regard to the level of obligation up to 20 per cent on a guaranteed headroom basis of 8 per cent is designed to increase industry certainty in the RO and ensure that the value of ROCs will be protected in the event that increased deployment will in turn increase the risk of over-compliance due to weather or market conditions in a given year.

3. The likely impact of the reform of the RO on renewable energy deployment

The implementation of the reformed RO has not had sufficient time to determine how it is actually operating. In order to evaluate the potential performance of the mechanism, this section will examine the OXERA modelled outcomes (and the model itself) by analysing the internal and external failures of the reformed RO. This type of analysis can help reveal the way in which the reformed RO addresses these failures and thus determine the likely impacts it will have on RES-E, particularly with regard to the set targets (2010, 2015 and 2020). The reformed RO has entered into force, but it is its implementation over time which matters in relation to the renewables targets.

3.1 Modelling the reform of the renewables obligation

The OXERA (2007) report, "Reform of the Renewables Obligation: What is the Likely Impact of Changes?" modelled a range of Scenarios based on an assessment of the expected current and forward costs over the next few years for each technology[4]. The modelling approach taken by OXERA's Renewables Market Model was to simulate the likely pattern of renewables investment, based on key assumptions, focused on the period up to 2015 although modelling was undertaken to 2027[5]. The key assumptions consist of two main sets of inputs: cost and revenue assumptions – the underlying components that determine the renewables supply curve over time (renewable generation costs, revenue assumptions and build rates) and model parameters – factors that define the mechanism (banding levels and shares of revenues and cost streams that the renewable generator or investor can expect to receive) (OXERA, 2007).

OXERA modelled six Scenarios including the non-reformed RO (the base case or "do-nothing" Scenario) and five banding Scenarios incorporating a range of sensitivities into their modelling (such as retaining, altering or removing the cap on co-firing and the RPI link to the buy out fund and changing the proposed support levels for RETs). However, this paper focuses on the modelling results for the base case and Scenario 6 (the proposed RO reform changes) as provided in the BERR (2008b) report. In addition, unless stated otherwise, only the central assumptions cases will be examined.

There are a number of issues that could affect the predictions of the model itself. The two main sets of inputs (the key assumptions) that influence the results of the OXERA model and upon which the model is based cannot be determined with a high level of accuracy, one of the main reasons why the model focuses only on the period up to 2015/2016. The banding Scenarios (including the reformed RO, Scenario 6) are "static" – there are no changes in the multiples (apart from co-firing) and the allocation of technologies to bands for the duration of the RO. Therefore, uncertainty inherent in the reform process is left unmodelled (British Wind and Energy Association (BWEA), 2008).

Although it is not the aim of this paper to critique the model *per se*, it is important to note the limitations of modelling – it is an artificial construct with a defined set of variables and interactions. It cannot take into account the real-time complexity of the issues involved. For example, although it would be very difficult (if not impossible) to include external failures (planning permission and transmission/distribution issues) into the model, these are major barriers to renewables deployment in the UK and as such will have an impact on the expected outcomes of the OXERA model and should be kept in mind. In addition, the model does not capture the benefits that would accrue from economies of scale and research and development incentives. The recent proposal to extend the mechanism until 2037 can only aggravate the expected outcomes of the model with regard to actual outcomes (this will be examined in more detail later).

Part (A) of Table III shows the costs and benefits derived from modelling the non-reformed RO and the reformed RO Scenarios (up to 2027). One measure of the efficiency of the instrument is the deadweight cost – the difference between the resource cost (the cost of the RETs) and the total subsidy costs. Although the resource cost is £3.3 billion higher under the reformed RO than for the non-reformed RO – to be expected with banding, because the total subsidy cost is not significantly higher between the two Scenarios, the total deadweight cost is lower (£1.9 billion). In addition, the reformed RO saves an additional 12.7 million tonnes of carbon (MtC) over the non-reformed RO with a reduction in the cost of displacing carbon emissions (cost effectiveness) of £5 per ton of carbon (t/C) saved (a significant value when considering the 12.7 MtC saved).

Although the total subsidy cost is £1.7 billion higher overall for the reformed RO, part (B) of Table III shows that it performs better with regard to the set targets for

(A) Estimated costs for the current RO and the reformed RO modelled Scenarios

	Base case *"the current RO"*	*Scenario 6* *"the reformed RO"*
Resource cost £bn	13.1	16.7
Carbon saved MtC	83.8	96.5
Cost effectiveness £/tC	177	173
RO deadweight cost £bn	8.4	6.5
Total exchequer cost £bn	1.7	2.0
Total subsidy (or consumer) cost £bn	21.5	23.2

(B) Estimated level of electricity generated from ROC eligible sources for the non-reformed RO and reformed RO modelled Scenarios

	2007 (%)	*2010 (%)*	*2015 (%)*	*2020 (%)*
Set target	6.7	10	15.4	30-35[c]
"The current RO"	4.9[a]	7.9	11.4	12.0
"The reformed RO"	–[b]	9	13.4	14.0

Notes: (A) all the categories above (except cost effectiveness £/tC) are for the lifetime of the RO mechanism, taken here the period up to 2027 (modelling does not take into account the extended duration of the RO – until 2037); *bn – billion, MtC – million tonnes of carbon saved, tC – one ton of carbon; (B) [a]This is the actual level achieved for 2007 (BERR, 2008a); [b]not applicable; [c]this is not an agreed target as yet, and therefore not binding (BERR, 2008d)
Sources: Adapted from BERR (2008c); OXERA (2007)

Table III.
Modelling outcomes for the non-reformed RO and the reformed RO Scenarios

electricity generated from renewable sources. In particular, for 2015 and 2020, the reformed RO is estimated to achieve levels 2 per cent higher than that for the current RO. In addition, the model shows that both Scenarios will fall far short of the proposed 2020 target, although this is in major part due to the effect of the previous (shorter) lifetime duration of the mechanism on investment decisions and expected revenues to investors.

3.2 The internal and external failures of the reformed RO

Table IV summarises the main internal and external failures to renewable deployment identified in this paper for the NFFO, the current RO and the reformed RO. Despite the changes to the RO, the reformed RO will still remain a strongly market-based mechanism where the market will determine price and technology choice in order to meet the deployment targets. Indeed, this was the reasoning behind the decision to adopt the multiple ROC approach (DTI, 2007b). The same price and financial risks remain due to the overall design of the RO as a financial support mechanism: a central problem is the considerable uncertainty about the future value of ROCs and the electricity itself (Toke and Marsh, 2006). In addition, as the Carbon Trust and L.E.K Consulting (2006, p. 2) report "Policy Frameworks for Renewables" points out, the RO:

> [. . .] by design passes regulatory risk to the private sector, which the private sector accordingly prices at a premium. This leads to a leakage of the subsidy away from developers, as suppliers take a margin to deal with this risk and funding from financiers is therefore available on less favourable terms than it would otherwise be.

Technology banding has been proposed primarily to counter the failures of the current RO, which was designed to "pull through" the lowest cost technologies sequentially but has only really supported the deployment of co-firing and onshore wind which have been seriously constrained primarily by supply chain under-development, land-use issues, planning permission and grid connection issues. It has also failed to close the funding gap for the less mature and more expensive RETs (e.g. offshore wind, wave, tidal stream and solar photovoltaic) and thus stimulate the necessary deployment levels required for the 2010 and 2015 renewable generation targets (Mendonça, 2007). In particular, offshore wind has the advantage of being near market mature, has the ability to deploy at large-scale and has a massive resource potential (Gross, 2004).

A comparison of the modelled projections for the non-reformed RO (part A) and reformed RO (part B) in Figure 1 shows quite clearly that the reformed RO is expected to significantly increase renewable energy output (in TWh) over the period 2002/2003 to 2026/2027 over the non-reformed RO. The major trend observed is that this growth is predominantly due to offshore wind power (and to a lesser extent, co-firing) whilst onshore wind shows a slowing in the rate of increase. Figure 1 also shows that, overall the other renewables category (excluding wave, tidal, onshore and offshore wind, landfill and co-firing) only increase slightly under the reformed RO than the non-reformed RO, in terms of output.

Figure 2 clearly shows the changes in the proportions of RETs to the overall generation mix between the non-reformed RO and reformed RO as projected by the OXERA model for 2015/2016 and 2020/2021 – the target "deadlines" set for achieving the 15.4 per cent and the proposed 30-35 per cent of electricity from RES-E. Figure 2, then, shows that the reformed RO is projected to significantly increase offshore wind in contrast to the non-reformed RO, but considerably less amounts of onshore wind than

Table IV. Summary of the main internal and external failures of the NFFO, non-reformed (previous) RO and the reformed RO

Non-fossil fuel obligation	The renewables obligation	The reformed renewables obligation
Internal failures		
Originally set to run for only eight years limiting time projects could expect to get financial help increasing risk	Price/financial risks: typically short-term contracts (no NFFO priority access contracts) with generators not knowing what they will be paid for each contract; difficult to obtain financing (two of four revenue streams depend on supply and demand)	Price/financial risks from the current RO still exist
Excessive competition to reduce average price/kWh of each bidding round led to contracted projects not being built as many accepted bids too low (unrealistic)	Volume risk: ROC value and buy-out premium decrease the closer to meeting the obligation targets; in-built incentive to not achieve set targets	Banding expected to significantly increase deployment of co-firing and offshore wind but is likely insufficient to significantly increase deployment levels of less mature technologies until at least by 2020 (the Emerging Band technologies, e.g. PV, wave, tidal stream)
Bidding structure meant most of those offered contracts applied for planning permission/ started plant construction at the same time – compounded by the first two failures and leading to a perceived "wind rush" and resultant backlash, thus exacerbating planning problems	Left technology choice to the market, thus promoted the cheapest technologies (onshore wind and landfill gas) and priced other RETs out of the mechanism) thus exacerbating planning problems	Funding change for RO administration costs (from the buyout fund/government making up any shortfall) likely to increase investor/developer uncertainty
Uncertainty of when bidding rounds would occur (and irregular intervals between when they did) and for which technologies/capacity amounts	Highly complex mechanism that strongly supported large, vertically re-integrated companies (that could take on the RO risks themselves) over smaller independent and community-based projects that have been proven to improve public acceptance/reduce planning failures	Review criteria too wide/vague – again increasing element of uncertainty
As NFFO bundled with nuclear power (until 1994), most of the subsidy (FFL) went to nuclear	Excessive focus on low costs exacerbated problems for UK renewable industry sector that developed under the NFFO	Co-firing emergency review if it breaches 10 per cent could increase uncertainty
No penalty mechanism to penalise failure to take up contract		Increased complexity of the mechanism overall, due in part to banding and leading to lack of transparency and supports larger companies over smaller independent and community based projects with resultant same problems as current RO

(*continued*)

Table IV.

Non-fossil fuel obligation	The renewables obligation	The reformed renewables obligation
Excessive fiscal constraints led to the UK manufacturers unable to meet equipment demand and developers going abroad Complex mechanism – supported big business		Uncertain whether increased subsidy levels (for certain technologies) will be enough to build up industry growth and resultant employment. This would be compounded by the emphasis on low costs and the scale of proposed deployment means developers likely to go abroad for equipment
External failures		
Local planning authorities not given guidance for renewable projects – thus exacerbating planning rejection Policy uncertainty: NFFO changed significantly in 1993 (extended contracts to 15 years); mechanism replaced after just eight years; originally bundled with nuclear power Transmission/grid connection issues same as for the RO but less of a problem due partly to far lower RES generating plant in operation than under RO and constraint issues problem of the grid company	Planning permission problems still not resolved Transmission/grid connection issues still not resolved Policy uncertainty/excessive changes: setting carbon trading as the key policy tool and notifying intention to review RO in 2003 (one year after RO started; obligation targets set late/non-binding; RO to be significantly altered (reformed) in 2009 NETA/BETTA increased balancing risks and forcing additional costs to renewable generators	New Planning Act expected to streamline/speed up process for renewables but potential top-down imposition of renewables on local communities and differentiation of projects by capacity/location could affect expected benefits Transmission/grid issues: significant reforms proposed for transmission/distribution but consultation process ongoing (see in text) Policy uncertainty: proposed 2020 target and RO extension (2037) not agreed officially BETTA problems still exist

Source: See Wood (2010) for a more in-depth examination of the internal and external failures of the NFFO and RO

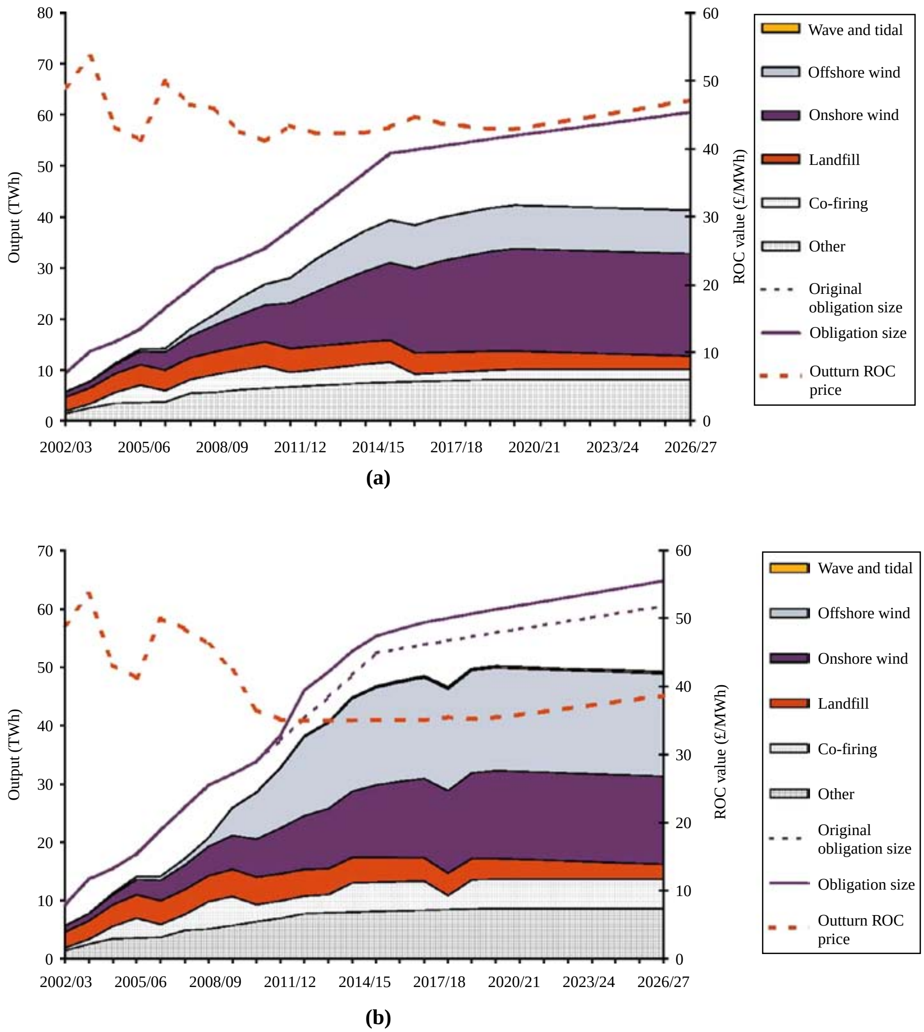
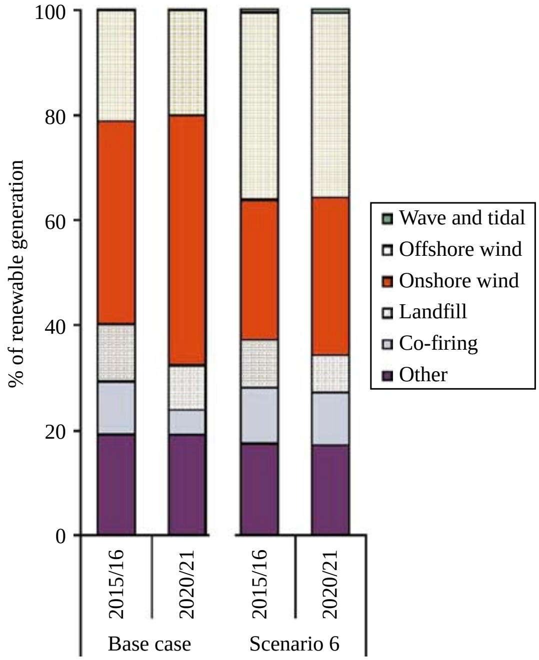


Figure 1.
OXERA modelled projections of renewable energy deployment volumes (in TWh) for the non-reformed RO (a) and the reformed RO (b) for the period 2002/2003 to 2026/2027

Note: Both figures incorporate the 2027 end-date for the RO mechanism
Source: OXERA (2007, pp. 12 and 31)

the non-reformed RO. This is in contrast to the substantially lower amount of onshore wind evidenced in the projections (BWEA, 2006). Of interest, total wind power and co-firing will contribute around 70 per cent of total renewable generation by 2015/2016. In terms of total renewable generation (as a percentage), wave and tidal power exhibit negligible growth under the reformed RO (and non-existent under the non-reformed RO).

Co-firing growth is maintained at a stable level under the reformed RO but undergoes a significant decrease under the non-reformed RO. When co-firing (regular)



Note: This figure incorporates the 2027 end-date for the RO mechanism
Soure: Adapted from OXERA (2007, p. 35)

Figure 2. Comparison of the generation mix by technology type for the non-reformed RO (base case) and the reformed RO (Scenario 6) for the years 2015/2016 and 2020/2021

and co-firing (energy crops) are examined separately, both categories show a marked increase under the reformed than the non-reformed RO. Indeed, co-firing of energy crops actually shows no deployment at all under the non-reformed RO although the increase under the reformed RO is insignificant (see OXERA, 2007, pp. 85 and 91 for a detailed breakdown). Landfill gas also declines further under the reformed than the non-reformed RO. Figure 2 (see p. 16) also shows that all other renewables do not change significantly for both the non-reformed and reformed RO mechanisms. A more detailed examination of this category reveals that solar photovoltaics and certain microgeneration technologies (micro CHP and Anaerobic Digestion CHP) do not deploy at all, biomass CHP exhibits insignificant deployment, whilst small hydro shows insignificant growth in deployment levels (OXERA, 2007, pp. 85 and 91).

Therefore, banding appears to offer the highest support to the more mature or near market and lowest cost RETs – offshore wind and co-firing (primarily with non-energy crops). In contrast, banding does not appear sufficient to significantly increase deployment levels of the other RETs (including onshore wind). In particular, those technologies in the Emerging Band show decreases (landfill gas), insignificant increases (wave. tidal, biomass with energy crops) or no growth at all (solar PV, micro CHP). In short, the inclusion of microgeneration in the highest subsidy band does not appear to improve the opportunity for microgeneration to contribute meaningfully to the future generation mix at all, especially given the recent reduction in grants by the

Low Carbon Buildings Programme – a major funding source for microgeneration. With regard to wave and tidal power, the Ernst & Young (2007) report stated that without any additional support, both RETs would require between 3.9 and 4.5 ROCs/MWh. It could also be suggested that onshore wind growth could be constrained by the shift to offshore wind and its higher level of support under the reformed RO (in addition to other barriers).

There are a number of issues that could affect the likely deployment ability of those RETs that are expected to contribute around 70 per cent of total renewable generation under the reformed RO by 2015/2016. For offshore wind, these include build rate constraints (can only be installed between May and September – the "calm weather window"), the requirement of dedicated dock facilities, ships and barges and installation plant. In addition, offshore wind faces a number of technical challenges and future costs remain uncertain due to limited market experience (Gross, 2004). Also, there is the possibility of a time delay in investors accumulating the financial benefits of the increased ROC allocation for offshore wind, leading to investment in new capacity coming later rather than earlier. These issues, in conjunction with other potential problems (e.g. planning) are important, given the recent launch of the Crown Estate's round three leasing programme for an additional 25 GW of new offshore wind farm sites by 2020 (in addition to the current 8 GW from rounds one and two) (The Crown Estate, 2008). Issues facing onshore wind and co-firing have been mentioned already (see above); however, if co-firing ROCs surrendered exceeds 10 per cent this could provoke an emergency review and increase uncertainty for investors. The impact of the extension of the mechanism up to 2037 will increase the likelihood of this occurring (in addition to its effect on renewable generation in general, see below).

With regard to net neutrality, it appears unlikely that the redistribution of support between the various RETs (from the most mature and cost-effective technologies to newer, developing technologies including offshore wind) could be achieved in a way that is net neutral in terms of costs and amount of renewable generation. Yet one of the four criteria for setting the bands (during the reviews) is that net neutrality should be taken into account (DTI, 2007b). This could lead to either the desired volume being delivered at a higher cost or a lower volume delivered at the same cost. This would particularly be the case for offshore wind, which would require additional funding support in order to deliver an equivalent amount of renewable energy by 2015/2016 (UK Business Council for Sustainable Energy, 2007).

The review criteria established to enable the government to trigger an early review (out with the proposed banding review timetable) is both very broad and very vague. This could act as an internal failure by increasing investor/developer uncertainty with regard to future income (if a technology is banded down, for example). The reformed RO, by design, removes long-term security for individual RETs due to the lack of certainty of knowing the future allocation of the number of ROCs per MWh. This could be a particular problem for offshore wind: if a future review banded down offshore wind as it became more cost competitive, this could leave companies facing potential stranding risk (due to the large expected level of deployment and the type of capital costs involved). However, it is important to note that the review process itself can also be beneficial. The government can learn from early mistakes or gained experience and it injects an increased level of flexibility into the reformed RO over the current RO. Such flexibility was one of the successful characteristics of the NFFO (Mitchell, 2000).

The proposed change in the way the administration of the reformed RO is funded is also considered here as another internal failure. The new system involves the administration costs (set to increase under the added complexity due to banding, thus increasing the overall cost to consumers) to be taken from the buy out fund, with government making up the difference in the event of a shortfall: however, there is no absolute guarantee that the government will make up the shortfall from the buy out fund, especially in the event of unforeseen additional expenses under the reformed RO. This could add to uncertainty for developers with regard to future revenue streams.

The issue of mechanism complexity still remains, and if anything, the reformed RO is more complex due to the introduction of banding (Table IV). Although there are a number of benefits to the proposed reformed RO, including maintaining RO levels above renewable generation up to 20 per cent, allowing the targeting of support to different technologies and providing a review mechanism for tapering support, it is by design more complex and the resulting impact of the reform on ROC prices will be difficult to predict. This leads to problems with regard to transparency and is also likely to be administratively burdensome. This added complexity, by itself, could act as a barrier to investment, especially to the entry of smaller independent and community-based companies – a problem that has plagued UK renewable energy policy since the introduction of the NFFO in 1990.

Four main external failures are considered with regard to the reform of the RO. Table IV reveals that, with the exception of the introduction of New Electricity Trading Arrangements (NETA) (subsequently altered to British Electricity Trading and Transmission Arrangements (BETTA)) in 2001, which still poses the same problems for renewables, the three other external failures – planning, grid connection issues and policy uncertainty – have acted as significant barriers to renewable deployment in the UK for almost two decades. The new Planning Act (November 2008) constitutes a fundamental change to the operation of the planning process in the UK. According to the government (*UK Parliament Online*, 2008), it:

> Introduces a new system for approving major infrastructure of national importance [including power stations, airport extensions, roads] and replaces the current regime [. . .] The objective is to streamline the decision-making process and avoid long public inquiries.

In summary, decisions will be taken by the new Infrastructure Planning Commission (IPC), with the decisions based on new National Policy Statements – to establish the need for major infrastructure projects, including energy projects). The hearings and decision-making process will be timetabled. The centre-piece of the new ACT – the IPC – has provoked considerable disagreement from environmental groups and within the government itself: it is an unelected (the government appoints the commissioners) and therefore unaccountable body that has the power to decide if any of the decision-making process will be heard in public. In other words, it removes the former system's focus on a public enquiry process[6].

There are two major relevant points for renewable energy. First, the new Act centralises the planning process, with the public losing the right to intervene in the process which offers limited rights to an oral hearing and the Act also removes the right of the public to call upon and question witnesses. This could lead to a top-down imposition of renewable projects on local communities and dent public optimism and approval for renewable projects overall (Harwood, 2008). Second, it establishes a cut-off point (in terms of plant capacity size and differentiated on whether a project is located onshore or offshore) which will determine whether projects will fall under the new IPC's jurisdiction or remain effectively under the former conditions for planning – however, with the absence of a professional planning inspector (Harwood, 2008). Onshore projects greater than 50 MW and offshore projects greater than 100 MW will therefore fall under the remit of the new IPC (Harwood, 2008).

The result of this is that relatively immature high-cost technologies that are located onshore (for example, solar PV and microgeneration) and offshore (wave and tidal power) that are not yet ready for large-scale deployment will remain under planning conditions similar to the former planning regime. This will have a particularly negative impact on the future contribution of wave and tidal power to renewable energy deployment, as developers continue to face costly and lengthy planning proposals at a time when they should be encouraged. In other words, small-scale renewable energy projects will remain unaffected and thus not benefit from the new Planning Act. Another effect is that those onshore wind farms larger than 50 MW (capacity) could be forced upon local communities, reinforcing the backlash against wind power that is already powerful in the UK. This top-down approach stands in stark contrast to the bottom-up approach adopted in countries like Denmark and Germany that have shown significantly higher deployment levels of onshore wind than the UK (Mendonça, 2007).

In contrast, the majority of offshore wind projects look likely to potentially benefit from the new Act (by avoiding lengthy, complex and costly public inquiries and the associated difficulties in successfully obtaining planning permission) as it is deemed uneconomical to build offshore wind farms less than 100 MW (BWEA, personal communication).

There is also the potential for conflict between the Planning Act and the Climate Change Act (November 2008). The duty to mitigate and adapt to climate change, inserted at the last minute into an existing duty on sustainable development in the Planning Act has been argued as vague as it does not directly mention renewables (Friends of the Earth, 2008).

As with the UK's planning regime, a number of significant reforms have been proposed for the transmission and distribution networks, partly in response to the government's 2006 Energy Review (Office of the Gas and Electricity Markets (OFGEM), 2008a). The ability for renewable generators to be able to connect to the transmission and distribution networks in a timely and cost-effective way will be very important if the EU target of 15 per cent of Britain's energy from RES-E by 2020 is to be achieved[7]. Although still in the consultation stage, a number of proposals have been put forward by both OFGEM and National Grid to alleviate the network barriers currently facing renewable generators.

With regard to the distribution network, the on-going price control review (for the period 2010-2015):

> [. . .] will place stronger incentives on DNOs [Distribution Network Operators] to lessen their impact on the environment [. . .] and to increase the connection of local, low carbon generation (OFGEM, 2008b, p. 2).

Although the consultation process for distribution is in its initial stages, this terming is very vague and increases in low carbon generation could equally mean nuclear, coal with carbon capture and sequestration as well as renewables.

A major change involves offshore transmission access, of potentially critical importance given that the government aims to install 34 GW of offshore wind capacity by 2020, mainly under The Crown Estate (2008) leasing programme. Proposed changes, also currently under consultation (ending June 2009), include the setting up of an independent offshore transmission operator and using the onshore use of system charges with locational charges (based mainly on distance from the source of energy demand). Recently, a revised system of use of charges was proposed, and there are worries that this, in conjunction with the slow pace of development could negatively affect the economics of offshore wind, introduce uncertainty and inhibit rather than support the policy objectives. However, the consultation process is not finished and there is still on-going debate about these issues (OFGEM, 2008c). With regard to overburdening the transmission network, the bulk of the strategic areas for the Crown Estate leasing programme's offshore wind zones lie south of the national grid boundary B1 (Cumbria to North Yorkshire) – above this boundary, transmission is already heavily constrained (Gross, 2004). This will alleviate concerns over critical transmission constraint although OFGEM estimates ~£5 billion is currently required for projects already propositioned.

For the onshore transmission network, proposals include transmission companies developing detailed investment plans that would deliver the transmission capacity required to reach the 2020 target and the development of a new financial incentive scheme so transmission companies would be able to both anticipate and build new capacity before securing contractual commitments from generators. Also, the existing "first come, first served" approach would be removed in order to create a level playing field for all generation – however, existing rules benefiting thermal generation would have to be changed for this to benefit renewables.

One of the major problems is that demand for network capacity currently exceeds supply, and existing rules favour thermal over renewable generation[8]. There is too little transmission capacity, especially in Scotland where it is already heavily constrained. Under the proposed reforms, part of the solution is to increase the overall capacity of the transmission network but this is normally delayed significantly due to planning issues. The Beauly-Denny upgrade waited for consent for four years (Parliamentary Office of Science and Technology, 2007). This problem might be relieved in the future by the new Planning Act, which has the objective of streamlining the decision-making process and avoiding long drawn out public inquiries. Importantly, the new Act allocates electric lines over 20 kilovolts to the jurisdiction of the IPC (Harwood, 2008) – the new decision-making body which effectively has the power to limit the public's right to intervene in the process. However, increasing overall capacity will still take time and OFGEM has proposed, for the interim, the "connect and manage" approach, which would allow renewable generators who could connect faster to make an application to National Grid to connect sooner. This could mean the rapid addition of over 1 GW of renewables being connected, although this is out of a total of 17 GW of renewable generation presently waiting in the connection queue.

UK renewable energy policy is still characterised by uncertainty, constant adjustments and change. The 2010 target remains the only binding objective to date: the 2015/2016 target remains an "aspiration", and the 2020 target – 15 per cent of the total energy mix and the RES-E sectoral contribution of 30-35 per cent currently stand as proposals (the government actually intends to abolish post 2015/2016 sectoral targets, see below) (this is also the case for the heat and biofuels sectors). In addition, carbon trading remains as the key environmental policy tool, thus undermining confidence in the renewable specific RO. However, the recent government proposal to extend the RO mechanism up to 2037 and possibly beyond is a significant adjustment, and quite probably a beneficial one. As Figure 3 shows, under the current duration of the RO (2027), there is no expected new RO-eligible generation after 2020/2021 with an overall decrease in new generation from approximately 2015/2016 onwards. This is a direct consequence of the finite duration of the RO impacting on investment decisions (there is no modelled expectation of future ROC revenues after 2027/2028) and the predicted remaining revenues (e.g. from the sale of electricity) would not be sufficient by themselves to bring forward new development despite the subsequent upturn in ROC values (OXERA, 2007). As OXERA (2007, p. 36) point out, the cut-off dates for investments:

> [. . .] suggests that the time frame for ROC revenue collection is a more dominant factor in investment decisions than the effect of banding.

The impact of the cut-off date is significant, as projects are simply not commissioned where repayment is not sufficiently assured before the cut-off date. Extending the cut-off date is not so much about trying to encourage projects during the extra time – it is concerned with avoiding the modelled outcome of a fall in projects as the cut-off approaches. It becomes an interesting question as to whether the system can therefore ever end.

Building in the extension to the RO alters the OXERA modelled outcomes for renewable energy deployment levels for both the non-reformed and reformed RO Scenarios. New generation levels would certainly not decline in the manner shown in Figure 3, and the chance of the headroom mechanism being triggered would increase. This is significant, given that non-RO eligible renewable generation (large scale hydro) would add approximately 1.5 per cent, onto the modelled levels of RO-eligible

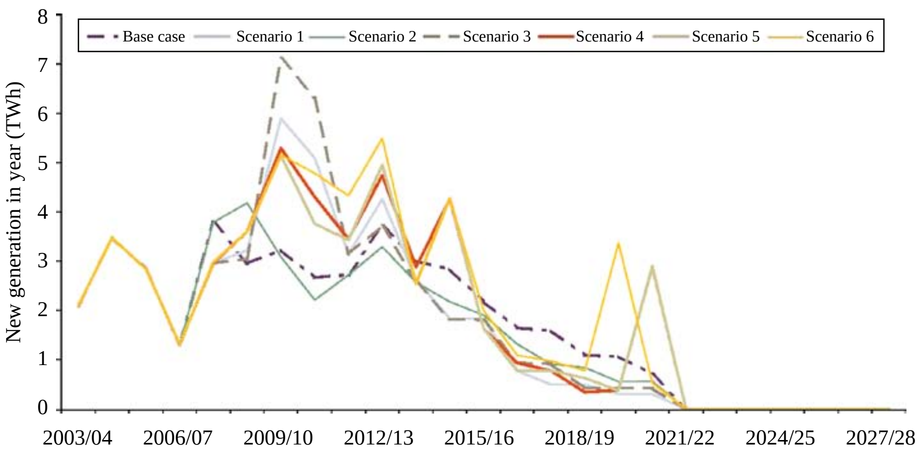


Figure 3.
Year-on-year levels of new generation 2003/2004 to 2027/2028

Notes: The data utilised in this analysis is based on the RO mechanism ending in 2027/28; the base case represents the non-reformed RO and Scenario 6 represents the reformed RO
Source: OXERA (2007, p. 35)

generation (DTI, 2007b). This crucially means that with the extension, the reformed RO implies that both the 2010 and 2015 targets could be achieved.

However, this again acts to highlight the doubt as to whether or not government has learnt from its past mistakes (cf. Wood, 2010). Policy uncertainty remains a significant failure for investor/developer confidence in the reformed mechanism: the White Paper "The UK Low Carbon Transition Plan: National Strategy for Climate and Energy" (DECC, 2009c) announced the government's intention to effectively further reform the reformed RO, only three months after it commenced operation. Proposed reforms include the replacement of RES-E fixed targets post 2015/2016 with a headroom mechanism; opening up the RO to include renewable generation from outside the UK; and introducing a mechanism to reduce or remove the risk of fluctuations in the wholesale price of power and possibly ROC prices. In effect, the government appears to be (in an unspecified way) attempting to reduce price risk by controlling wholesale electricity and ROC price fluctuations, removing uncertainty for developers/investors – one of the main internal failures of the RO, reformed or otherwise. It is out-with the scope of this paper to evaluate the potential impact of these proposed reforms; however, if these proposals are adopted, the impact on renewable development will be considerable – although it is currently impossible to say whether for the good or bad. Presently, there is a round of consultation and the proposals are contingent on obtaining state aid approval from the EC and parliamentary approval.

3.3 The likely impact of the reformed RO on renewable energy deployment levels

3.3.1 2010: RO reform will have little or no effect. Investors were uncertain of what was being proposed until there was insufficient time to plan and build sufficient capacity in the necessary timescale, or for increased subsidies under banding to accumulate sufficiently. The updated reform proposals were only published at the beginning of 2008 (BERR, 2008c). In addition, the new Planning Act, which could reasonably be expected to increase (at least large-scale renewable) deployment, only came into effect towards the end of 2008. No real grid improvements have come into effect, except the "connect and manage" approach which could possibly explain some of the increase in deployment projected by modelling between the non-reformed and reformed RO. Retention of the main failures of the mechanism, including high price risk/uncertainty and policy uncertainty have continued to act against the performance of the reformed RO.

In short, it is hard to understand where the increase in renewable capacity comes from for the reformed RO as opposed to the non-reformed RO (9 per cent contra 7.9 per cent, respectively), given the above reasons, although it should be noted that the proposals on grandfathering have encouraged increasing deployment of RETs, in particular offshore wind (although co-firing is exempted). This is due to the fact that any generating capacity which became operational or achieved planning permission after 11 July 2006 (after the publication of the Energy Review but before 1 April 2009, the designation date for the reformed RO) will:

- have retained its entitlement of 1 ROC/MWh in the case of technologies being banded down; and
- have moved to its higher entitlement in the case of those technologies being banded up (DTI, 2007b).

An evaluation of the likely impacts of the internal and external factors suggests that the projected increase of 1.1 per cent between the reformed and non-reformed RO as implied by the 2007 OXERA report could be construed as optimistic (for example, renewable deployment only increased by just over 0.5 per cent for the period 2007-2008). Overall, the 10 per cent target for 2010 will not be achieved. The reform and the associated external measures simply occurred too late.

3.3.2 2015: RO reform should start to make a significant impact. The time period up to 2015/2016 means that there is more time for the changes to filter through (the period up to 2015 has been the focus of the government approach for banding). The new Planning Act should ease planning constraints, and by primarily aiding large-scale wind projects (offshore and onshore), increase overall deployment levels. However, this will be heavily dependent on two main factors:

(1) Currently, it takes between eight and nine years for an offshore wind farm to go from site decision to operation (BWEA, 2008) – the actual time it will take under the new planning regime is currently unknown but large-scale projects should expect a reduced duration.

(2) The precise proposals currently in consultation for the grid (distribution and transmission) for onshore and offshore development and how quickly they can be implemented.

Access to the grid is critical if renewable deployment is to be increased, and increasing overall network capacity (one of the fundamental external problems) would take a number of years before any benefits became significant, thus limiting the potential for renewable deployment in this time period. However, if enacted in time and successful, the proposals already set out would be expected to at least alleviate the problem and help increase deployment levels – particularly for offshore wind (the 2008 Planning Act should help grid building too).

Co-firing is also expected to make a significant contribution under the reformed RO than the non-reformed RO, primarily due to the cap-effect for the latter mechanism. There is more time for the benefits of increased subsidies for those banded up RETs to accumulate to investors, although it appears insufficient to stimulate growth in RETs apart from offshore wind. However, the Scottish Government (2008) is proposing to increase ROC allocations for wave and tidal energy to 5 ROCs/MWh per technology. It will be interesting to see (if it occurs) whether or not this will have a significant impact on deployment levels for these and other RETs, or whether it simply causes a relocation of already-planned investment levels.

Another major issue for this time period is the occurrence of the first review, planned for 2013 (as long as the emergency criteria are not activated, triggering an emergency review). Apart from microgeneration, there is no assurance that the different RETs will remain in the band that they have been allocated to for the start of the reformed RO. Although this makes it virtually impossible to second guess what will happen, it is important to recognise that this process could have a strongly negative impact on deployment levels as it increases uncertainty. However, the government has also acted positively by increasing subsidy levels for offshore wind over the period 2010-2012 due to problems specific to this RET.

The extension of the RO mechanism until 2037 should start to have a positive impact on overall deployment levels due to increasing confidence over the prolonged duration of future ROC revenues, although the real benefits should only be expected to occur post 2015/2016 with substantial increases over the OXERA modelling outcomes post 2020/2021 onwards. This should reverse the year-on-year decline in levels of new generation and should increase overall deployment levels, particularly towards the end of this period (Figure 3).

The OXERA modelling outcomes show that the reformed RO is projected to perform significantly better than the non-reformed RO (13.4 contra 11.4 per cent, respectively). This seems a reasonable projection, although reducing grid constraints (and the establishment of the offshore transmission regime) and the success of 2008 Planning Act will be critical factors in whether or not it occurs. Project duration also has to be reduced significantly, given that most of the increases in deployment are expected to come from offshore wind (8 GW currently under development; the 25 GW proposed under round 3 will not affect the 2015/2016 targets). On the assumption that the constraints mentioned here are substantially reduced over the relevant timeframe, there is the possibility that the target of 15.4 per cent could be reached.

Although not addressed in this paper, the new reforms proposed in the 2009 White Paper "The UK Low Carbon Transition Plan: National Strategy for Climate and Energy" (DECC, 2009c) are worth keeping in mind, due to the substantial potential impact they could have for renewable energy deployment in the UK (see Section 3.2). This will also be an issue for the 2020 target.

3.3.3 2020: RO reform should make the biggest impact. The OXERA model projected a significant reduction in year-on-year growth in new generation during this period (2015/2016 to 2020/2021), with no new growth after for both the current and the reformed RO. This was a direct consequence of the effect that the finite life of the mechanism would have on investment. In this paper, the extension of the RO to 2037 is used in evaluating the likely impacts of the internal and external failures on renewable energy deployment levels. Therefore, the conclusions here diverge quite significantly from those of the OXERA report. Specifically, the RO extension is likely to be the biggest factor in increasing renewable energy deployment levels in this period for all RETs that showed growth under the reformed RO modelling outcomes and possibly those that did not such as wave power (see below).

By 2020, there will have been more than adequate time for the full benefits of the proposed reform of the grid system (transmission and distribution), and network capacity should be increased to some extent. In addition, the full benefits of the 2008 Planning Act should be felt. However, the grid consultation process needs to be completed in order for the full extent of the regime change to be known, particularly with regard to renewables (for example, will use of system charges and current deep charging for the distribution network be reformed?).

In addition, the 8 GW of offshore wind from round 2 and a significant number of round 3 (25 GW) of the Crown Estate's leasing programme should be in operation. Again, this would be dependent on turbine constraints, grid regime change and how quickly the new planning regime is in comparison to the former system. Growth in large-scale projects (> 50 MW onshore and > 100 MW offshore) should see increased deployment levels for all wind power, and in conjunction with the future certainty of ROC revenue due to the RO extension, an increased growth, in contrast to the projected model, in wave and tidal power deployment could also occur under the reformed RO (but highly unlikely under the non-reformed RO due to the lower subsidy level available).

If the Scottish Government's proposal to increase ROC allocations for these technologies occurs, this should further increase their deployment levels over the modelled outcomes although it would appear unlikely that they will contribute significantly to renewable deployment levels until after 2020.

However, there are also a number of constraints to be considered. As with the previous period (2015), the second review will occur in 2018. Also, co-firing will most likely have reached the 10 per cent cap level, if not considerably before. In conjunction, unless a new target above the current 15.4 per cent is officially set, a slowing down of development could occur, despite the level of obligation the reform established to maintain RO levels above renewable generation up to a maximum of 20 per cent. This issue is made more critical given the boost brought about by the RO extension. Of importance, the government has proposed de-coupling renewable deployment from set targets post 2015/2016 by replacing the targets with a headroom mechanism (see Section 3.2).

The OXERA model estimated 2020 renewable deployment levels to increase more under the reformed RO than the non-reformed RO (14 and 12 per cent, respectively). However, in view of the effect of the RO extension on the internal and external failures evaluated here, it is highly likely that deployment levels would be much higher, especially given the likely benefits mentioned above. Again, this is strongly dependent on the constraints being lessened, particularly with regard to the grid. Achieving the proposed 30-35 per cent RES-E target, however, still appears highly unlikely for both mechanisms without some form of additional support.

4. Conclusion

Since 1990, the UK has operated two support mechanisms for renewable energy, the NFFO and the RO. Although the UK is recognised as having some of the best renewable energy resources in Europe, particularly with regard to on shore and offshore wind, wave and tidal power, both mechanisms have consistently under-performed with regard to renewable energy targets, at both the national and European level. Despite strong policy commitments to move to a low carbon economy with renewables seen as a politically vital way of achieving this, and the Climate Change Acts (for England and Wales and Scotland) setting a legally binding world leading cut in carbon dioxide emissions of at least 80 per cent in 2050, the UK currently lags behind other European countries and in particular, those countries utilising the REFIT mechanisms (Germany, Spain and Denmark).

Although RES-E generation has increased at a greater rate under the RO than for the NFFO – from 1.9 per cent in 2002 to 5.5 per cent in 2008, in terms of the original RO it is very unlikely that the set targets for 2010, 2015 and 2020 would be achieved (Table III). Primarily this is due to a combination of internal and external failures of the mechanism, in particular a high price risk/financial uncertainty environment for investors/developers. Also, overall deployment has been frustrated by external failures such as planning and grid issues. This situation was aggravated by a focus on onshore wind as the mechanism failed to "pull through" the lowest cost technologies sequentially.

This led to the move to reform the RO, a policy move primarily to deal with the failures of the previous mechanisms. The government introduced banding based in large part due to the OXERA modelling which projected increased levels of deployment growth mainly by "pulling through" more costly but near market technologies by increasing subsidy levels, in particular offshore wind.

In order to evaluate the effect of the proposed reforms, the OXERA modelled outcomes (9 per cent for 2010, 13.4 per cent for 2015 and 14 per cent for 2020) were investigated in this paper by taking into account the likely impact of the internal and external failures of the reformed RO. This showed that the reformed RO would likely increase overall renewable energy deployment levels in comparison to the previous mechanism, mainly due to offshore wind, although there would likely be little or no real effect with regard to the 2010 target. The periods up to 2015/2016 and up to 2020/2021 were found to show the most benefit from the reform of the RO, with the 2020 target showing the biggest increases in deployment.

The paper shows that although the reformed RO will increase overall subsidy levels and the government has attempted to address the main external failures (by introducing the new Planning Act, and consulting on grid reforms), but by not addressing the issue of high price/financial risk and uncertainty, and increasing overall mechanism complexity, the paper has shown that the major internal failures have still not been fully addressed. This is where reforming the RO could have made the most impact on improving deployment levels, but arguably ended up being another missed opportunity, although adjustment to include changes to the external failures would have significantly widened the influence of the RO. As an alternative to the decision made with the reformed RO, perhaps altering the primary goal from price reduction to deployment (by incorporating some sort of price stability) would have addressed such failures and increased renewable deployment levels (in similar fashion to REFIT schemes). In addition, the success of the reformed mechanism will again be heavily dependent on a select few technologies – primarily offshore wind and co-firing (both of which face technology-specific problems), and whether or not the (now separate) measures to combat external failures are successful.

The extension of the RO mechanism to 2037 (and possibly beyond) is likely to be the single most important factor behind the increase in renewable deployment levels, particularly for the 2020 target. Whilst it is too late to influence the 2010 target, the extension means it is possible that the 2015 target might be achieved, and certainly the projected levels for 2020 will be higher than that set out in the OXERA modelling. With regard to the later targets, the analysis carried out here suggests that the 2015/2016 target could be reached under the reformed RO. In contrast, it is difficult to see how the proposed 30-35 per cent RES-E target for 2020 could be reached, even with the mechanism extension (although the recent White Paper puts forward the proposal to replace sector targets with a headroom mechanism, which is certainly one way to avoid such a problem). It cannot be emphasised enough, however, that the increases in deployment set out here will be strongly dependent on a few technologies and the success of the reforms of the planning and grid systems, two external barriers that have continuously plagued UK renewable energy policy since the beginning. As with the non-reformed RO, the reformed RO supports large, vertically re-integrated energy companies over small-scale or community-based companies/projects and policy uncertainty appears likely to continue undermining confidence in the renewables sector. This failure is highlighted by the White Paper "The UK Low Carbon Transition Plan: National Strategy for Climate and Energy" (DECC, 2009c) which proposes a new consultation round with what are arguably as far reaching reforms, if not even more so, than the changes from the original RO.

Notes

1. The sectoral approach consists of establishing separate targets for electricity, biofuels and heat/cool – however, although there is the 2003 EU Directive on Biofuels no pan-EU targets have been set for the important heat/cool sector.
2. This has been the underlying reasoning behind the RO in particular and the UK's renewable energy policy in general (Wood, 2010). With regard to the two approaches mentioned here, the multiple obligation approach is viewed by some as being overly complex and overly interventionist.
3. This was previously worded – if ROCs from co-firing (regular) contribute to more than 10 per cent of the obligation.
4. The cost data utilised in the modelling was based on the Ernst & Young (2007) report "Impact of Banding the Renewables Obligation – Costs of Electricity Production" that estimated the levelised costs for RO-eligible RETs for the years 2010, 2015 and 2020.
5. This was the original termination date for the RO – in November 2008, the government proposed to extend the mechanism until 2037 (*Guardian Online*, 2008).
6. This gave local people the chance to give evidence and call and cross-examine experts before a professional planning inspector reported the outcomes to the government for an elected Member of Parliament to make a decision.
7. Government Scenarios indicate that more than 37 GW of renewable generation will need to be connected to the electricity network – Britain's total installed capacity is currently 80 GW – in order to achieve this target (BERR, 2008d).
8. The reason for this is that thermal generation forms the majority of capacity in the UK, are the cheaper generation option (in comparison to renewable generation) and the system is basically a market.

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